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ABSTRACT

A study assessed the variable amounts of attention that are required for a viewer to process two kinds of interruptions that commonly occur in television: the shift from one message to a different, unexpected message; and the reference to previously presented material that follows an interruption. Twenty-six subjects recruited from an upper-division course in communication research methods viewed a 30-minute videotape composed of 24 different sequences of programs. Each sequence consisted of an initial segment that introduced one program, an interrupt segment that presented a second program, and a re-orienting segment that presented material from the first program. Attention was measured using reaction times to audio tones that were located 1 second and 6 seconds after the onset of the interrupt and re-orient segments. Results indicated (as predicted) that 30-second initial sequences produced longer response times (more attention) during the interrupt segments. Results also indicated that for the re-orient segments, 30-second initial segments required more attention (contrary to the hypothesis), and 30-second interrupt segments also required more attention (confirming the hypothesis). The results reconciled previously conflicting results of research on attention to television over time, and indicated the importance of defining message units in the cognitive processing of television. Future research should focus on integrating natural aspects of the television stimulus with an experimental agenda that treats television viewing as a cognitive process. (Three figures are included; 25 references are attached.) (PRA)

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We Interrupt This Program...Attention for Television Sequences

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WE INTERRUPT THIS PROGRAM...ATTENTION FOR TELEVISION SEQUENCES

This experiment assesses the variable amounts of attention that are required for a viewer to process two kinds of interruptions that commonly occur in television: the shift from one message to a different, unexpected message; and the reference to previously presented material that follows an interruption. Two research questions are addressed in this design: 1. Is attention to new, interrupt information independent of the previously presented information? 2. What makes reference to a previously presented television program easy or difficult? Sequences were composed of three segments: an initial segment drawn from one program, an interrupt segment drawn from a second program, and a re-orient segment that continued the presentation from the first program. The two factors in the design were the length of the initial segment (10 sec, 30 sec) and the length of the interrupt segment: (10 sec, 30 sec). Attention was measured using reaction times to audio tones that were located one sec and six sec after the onset of the interrupt and re-orient segments.

As predicted, 30 second initial sequences produced longer response times (more attention) during the interrupt segments, especially at the six sec tone location. For the re-orient segments, 30 second initial segments required more attention (contrary to the hypotheses), and 30 second interrupt segments also required more attention (confirming the hypothesis). These results reconcile previously conflicting results in attention to television over time, and indicate the importance of defining message units in the cognitive processing of television.

Introduction: We Interrupt This Program...Attention to Television

When individuals watch television they rarely view a program that unfolds without some type of interruption. Interruptions can occur within a program, such as when the action shifts between scenes from one time and place to another, or they can occur between messages, such as when a commercial break is inserted within a program. These two kinds of interruptions are often combined following an advertisement, when the previously presented program is resumed. Finally, interruptions can also occur over longer time periods that extend beyond a single viewing session, such as when episodes are continued over the course of a number of evenings or even weeks. This experiment is designed to assess the variable amounts of attention that are required for a viewer to process two kinds of interruptions that commonly occur in television: the shift from one message to a different, unexpected message; and the reference to previously presented material that follows an interruption.

Two research questions are addressed in this design:

1. Is attention to new, interrupt information independent of the previously presented information?

2. What makes reference to a previously presented television program easy cr difficult?

There are two components of this second research question:

2a. Is attention to new information that refers to previously presented information independent of the amount of information that was initially transmitted?

2b. Is attention to new information that refers to previously presented information independent of the length of the interrupt that separates the initial from the subsequent exposures?

The first research question is concerned with how viewers first recognize, and then shift their attention when an unexpected message is presented that interrupts a previous message. The series of questions related to the second research question is concerned with the amount of attention required to re-orient back to a program that had been seen prior to the interruption. These questions are answered by measuring attention to television sequences that are composed of segments that contain an initial segment from one program, an interrupt segment taken from a second program, and a re-orient segment that refers back to the first program presented in the initial segment.

The Role of Structure in Television Sequences

Television programs unfold in real time, so the task of integrating new information with previous information is continuous. A number of structural conventions are used in television sequences that indicate when information should be integrated with previous information. These conventions serve as visual and aural markers, so that viewers can distinguish breaks between programs, such as when a scene ends and a commercial begins. Structure also makes a number of demands on attention. A structural shift such as a cut, which is a discontinuous

transition between successive frames of video, indicates that new information has been presented. This new information could simply be a different camera angle from within the same scene, or it may indicate a shift across time and space, such as a flashback, or refer to a character that is important to the most recent scene, but is not present. These spatio-temporal shifts are cognitively demanding because they require the viewer to integrate information about different characters and locations, as well as different perspectives within these locations. But they also assist the viewer in this task by indicating transition points between messages.

Structural shifts are an important mechanism in the processing of interruptions because they serve as visual markers, indicating that a shift has occurred in the visual presentation. Geiger & Reeves (1989) focused on one type of shift, cuts, and their influence on attention to television. Viewers were exposed to two different types of sequences, related and unrelated. A related sequence simply consisted of 70 seconds drawn from a single television program, with no additional editing or manipulation. Unrelated sequences were constructed by editing together different segments of television drawn from completely different programs. Attention to sequences that contained related and unrelated cuts was assessed using a reaction time measure. More attention was required when a structural shift occurred between semantically unrelated segments of television, than between semantically related segments. Differences between

related and unrelated sequences of television were found to be greatest one second immediately following a cut.

These results indicate the importance of semantic relatedness in how structural shifts are processed within a one second window. Over the course of viewing the sequences, responses to cuts within a related sequence became easier over time, especially after the first 10 seconds of a sequence, while unrelated sequences showed no decrease in demands on attention. In the current experiment, both unrelated and related segments have been combined into a single sequence so that attention to new as well as previously presented information may be assessed.

Orientation to New Information

The following research question will be addressed in this section: is attention to an interruption independent from the information that preceded the interrupt? This question is concerned specifically with the influence of the length of the preceding message on attention during the viewing of a second message that interrupts the first. Attending to a segment that contains new, unexpected information requires first recognizing this information as new, and determining its relationship with the previously presented information. Since the initial and the interrupt segments are taken from different programs, the viewer's task is to shift from one program to the next. While this shift requires recognizing the two segments as independent,

the processing that occurs prior to the shift should have some influence on attention after the shift. Measures of attention would in this case indicate a recognition for the shift, and the ensuing mental effort required to process the new information.

A series of conflicting results have been obtained that pertain to how attention to television sequences shifts over time. Results that watching related programs requires less attention and becomes easier over time have come from studies that measure attention as mental effort (Geiger & Reeves, 1989; Hochberg, 1986; Reeves & Thorson, 1986; Thorson, Reeves, & Schleuder, 1985). Other researchers have described television viewing in terms of an attentional inertia, a phenomenon that describes the increased probability that children will continue to view a program the longer that they have been viewing. This is taken as evidence that attention increases over time (Anderson, et al., 1981; Anderson & Lorch, 1983; Meadowcroft & Watt, 1990). This tendency to continue looking emphasizes selection and interest in a message over mental effort. Clearly the two imply different processes over time; attention decreases over time when a message is related, while the likelihood of maintaining an orientation to the message increases over time.

While this study defines attention in terms of mental effort, the results for attentional inertia have one important implication; the ease with which viewers can shift from one program segment to the next. Since viewers become more engaged over time, attentional inertia would predict that if someone is

presented with a relatively long television message, it would be more difficult and require more attention for a viewer to orient to a different message, than if a shorter message were to be presented. In this research design, subjects were presented with initial message segments of either 10 or 30 seconds, followed by an interrupt segment. The selection of these levels was based on results that showed attention to related sequences was reduced significantly between these two durations within a sequence (Geiger & Reeves, 1989). Based upon these results and on the results for attention inertia, the prediction for attention to interrupt segments is that it will be more demanding to shift from one program to the next when the initial program segment is 30 seconds, than when the initial program segment is 10 seconds.

> Attention Hypothesis 1: Attention to a new segment that interrupts an initial segment will be greater when a long initial segment is presented than when a short initial segment is presented.

Integration of New and Previously Presented Information

There a number of factors that should make the reference to a previously presented television program easy or difficult, such as the coherence of the segments connected, and the length of the interruption that intervenes between two segments taken from the same program. Comprehending a segment that refers to previously presented information requires a viewer to do two things:

1. To recognize that new information has been presented that

differs in content from the immediately preceding interrupt segment; and, 2. To also recognize that it refers to information originally presented in the initial segment. When processing a sequence of text or television, new information can be treated in a number of ways (Bower & Cirilo, 1985). When the new information refers to previously presented information that is still active in working memory, then the new information can be integrated into the currently active representation. A more demanding task involves reinstatement, where new information refers to prior information that is not available in working memory, and must be activated. Finally, new information that does not refer to given information requires a reorientation, or an activation of completely new nodes and a new pattern of activation that represent the concepts, characters, and plot that are presented in the new information.

The distinction between integration and reinstatement is often based upon the amount of time and information that has intervened between the new information, and the old information that it refers to (Carpenter & Just, 1977). One area that has received a great deal of attention in the integration of new information with previously presented information is the comprehension of referents in a text, i.e. mentions of a character, object, or concept that have been cited earlier in the text (Dell, McKoon & Ratcliff, 1983; Haviland & Clark, 1974; McKoon & Ratcliff, 1980a). McKoon & Ratcliff (1980b) looked at reference to previously occurring concepts in a text, a process

that involves three stages: locating the referent, activating it into working memory, and connecting it to the earlier occurrence of the concept. Recognition times for words presented in the first sentence of a paragraph were faster when the last sentence in the paragraph contained a reference to the same concept. Facilitation also occurred between a concept and other words located in the proposition that contained the concept. The time course for the activation between the concept and its referent demonstrated a very rapid onset of facilitation (Dell, McKoon & Ratcliff, 1983). Haviland & Clark (1974) presented subjects with sentence pairs where the first sentence provided a context for the second sentence. Target sentences were comprehended faster when they were preceded by context sentences that contained explicit antecedents than when context sentences referred to antecedents indirectly.

Research in text processing indicates that integration is the least demanding (Clark & Haviland, 1977), and reorientation the most demanding of these types of tasks (Kintsch et al., 1975). One explanation can be based on an associative model of memory (J. R. Anderson, 1983a). In this model, viewers build an active network of associated concepts in working memory as they view television. New information is integrated faster because the pattern of activation has spread to corresponding nodes representing concepts that are congruent with the new information. When there is a high degree of commonality between contiguous segments, in plot, theme, characters, and setting,

then this integration task is relatively easy, since the related concepts are already activated. The pattern of semantic activation is simply updated to include the new information with the prior information.

In certain cases, new information can refer to given information that is not currently active. For example, a character introduced early on in a program reappears, or two parallel plots are alternated in their presentation. When a previously seen person or theme is re-introduced, then the referenced item must be retrieved from memory into an active state. Segments can also be discontinuous in their semantic relatedness. When shifts occur between programs, or when a program is interrupted by a commercial or change of channels, then the viewer is required to reorient to the new information. This requires activating a completely new associative network, a more demanding task (Geiger & Reeves, 1989). When the interruption is concluded, the information often refers back to an earlier presentation, requiring another reorientation and re-activation of the pattern that was associated with the previous information.

The proposed associative model of processing of television sequences is in many ways analogous to models of text processing. Both television and text present complex messages over time. The basic cognitive processes of pattern recognition, activation of codes, and assignment of meaning are comparable between the two tasks (Bower & Cirilo, 1985). Lichtenstein & Brewer (1980) have

shown that comprehension and memory for videotaped events behave similarly to stories presented in text. In the case of television processing, viewers are required to make note of the shift, and to determine the relationship between the new information in the re-orient segment and the previously presented or given information from the initial segment. This requires the recognition of concepts, characters, and settings that refer to previous ones, and the ability to discern the relationship between the current information and the previous information. When an initial exposure to a character or theme in a television program is well developed, it should contain an extensive associative network, while poorly developed and more brief presentations should be reflected by less developed representations. Therefore, it should be easier to recognize new information as a referent for previously presented information when the previous, initial segment is presented for a longer duration.

> Attention Hypothesis 2: Attention to information presented in the re-orient segment that refers to previously presented information from the initial segment, will be greater when the initial segment is short than when the initial segment is long.

The second factor that influences attention during a re-orient segment is the amount of time that intervenes between the re-orient segment, and the previous segment that it refers to. In instances where the current information refers to given

information that is presently active, the integration task will be relatively facile. When the given information is not active, then the reinstatement and connection of this information to current information will require more effort and attention. This was addressed by manipulating the length of the interruption that intervened between two segments of a message that were from the same program. Integrating new information should therefore be faster when the interrupt is short than when the interrupt is relatively long.

> Attention Hypothesis 3: Attention to information presented in the re-orient segment that refers to the initial segment will be greater when the interval between the new information and the referenced information is long than when it is short.

Methods

Subjects

Twenty-eight subjects were recruited from an upper-division course in communication research methods. Each subject was paid five dollars and received class credit for their participation. Ten of the subjects were men, and 18 were women. Two subjects' records were deleted from the final data analysis, one because of technical failure of the apparatus; the second was randomly deleted to balance out the number of subjects in the two presentation conditions (n=26).

Stimulus Materials

Subjects viewed a thirty-minute videotape composed of 24 different sequences of programs. Each sequence consisted of an initial segment that introduced one program (segment A1), an interrupt segment that presented a second program (segment B), and a re-orienting segment that presented material from the first program (segment A2). The sequences were edited so that the last frame of the initial segment was the first frame in the re-orient segment. The breaks between the A1 and A2 segments were chosen so that they would reflect a natural shift, such as the end of a sentence, and so that the first few seconds of the A2 segment would contain no structural shifts that would be confusing. All of the program segments were drawn from television programming broadcast during the Fall of 1989, over the three networks, PBS, and one independent station in San Francisco. No advertisements, animation, or children's programming were included in the presentation.

The constructed sequences differed on two dimensions: the length of the initial segment (A1), and the length of the interrupt segment (B). Each of these segments lasted for a duration of either 10 or 30 seconds, producing a four level factorial combination of different sequences: 1) 10 second initial, 10 second interrupt; 2) 30 second initial, 10 second interrupt; 3) 10 second initial, 30 second interrupt; and 4) 30 second initial, 30 second interrupt. The overall presentation time for the initial and the re-orient segments that presented

program A was held constant at 40 seconds. Therefore, the length of the re-orient segment was determined by the length of the initial segment. In instances where the initial segment duration was 10 seconds, the re-orient segment duration was 30 seconds. When the duration of the initial segment was 30 seconds, the re-orient segment duration was 10 seconds. This was done to ensure that the overall presentation time of the program depicted by the initial and the reorient segments was equivalent across the four different types of sequences. The differences in length between the re-orient segments were not treated as a factor in the design. The total length for each of the sequences was either 50 seconds, for the cases in which the interrupt segment duration was 10 seconds, or, when the interrupt segment duration was 30 seconds the sequence length was 70 seconds.

Every subject viewed six examples of each of the four different types of sequences, for a total of 24 different sequences. Each sequence was composed of segments taken from two different programs that were not repeated in any other segment. Therefore, a total of 48 different programs was represented in the stimulus materials. The particular segments were selected using the following criteria: 1) the segments were part of a narrative and were presented in a logical order; 2) each segment began at the start of some conversation, action, or event so that it was comprehensible as an isolated unit; and 3) all conversation and action occurred in a single location, with no transitions across time or space.

The segments were selected in order to represent the full variation of different types of television programming. These included news broadcasts, situation comedies, dramas, and action-adventures. Each segment presented at least two different characters involved in a conversation with the exception of the news segments. The news segments were composed of clips that included a reporter's voice over narration, and on-camera interviews. Segments that focused on a conversation were chosen so that the level of activity, and the information presented over the audio channel would be roughly equivalent. Each segment contained a number of structural shifts such as cuts, zooms, and other camera motion. In all instances, cuts were used to present a different camera angle or emphasis on objects or characters within a single setting, and did not involve transitions between settings. The segments that were ultimately selected were not altered in any way. The only editing that occurred was in the construction of the sequences, which required tagging each segment onto the previous segment.

Two different versions of the 24 sequences were constructed, each with a different presentation order. Each of the four different sequence types was presented within a block, before the next replication of that sequence type was presented. Therefore, subjects saw six blocks, each containing one of the four different sequences. This was done to minimize the effects of the placement of a sequence within the overall presentation order, and to control for a confound of sequence type and

location within the global order. The sequences for the first presentation order were selected randomly. The second presentation order was a mirror image of the first, with the first block of sequences for order one serving as the sixth block for order two, the second block from order one as the fifth block in order two, and so on. The presentation order within each of the blocks was also changed between the two orders. The two orders served as the only between-subjects factor in this design. In each tape, the 24 sequences were separated by 10 seconds of video black. This pause was inserted to minimize order effects within the presentation. The entire presentation time was 30 minutes and 48 seconds.

Design and Dependent Measures

Three within-subjects factors were used in the design: 1. The length of the initial (A1) segment (10 or 30 seconds in length); 2. The length of the interrupt (B) segment (10 or 30 seconds in length), and 3) The location of the audio tone within each of the segments (one second after the onset of a segment, and six seconds after the onset of the segment). One between-subjects factor was used, the presentation order of the sequences. There were a total of six replications in each of the cells within the design.

The dependent measure was the latency of response to audio tones. All tones were 1000 Hz with a duration of 100 msec. To assess the time course of attention, tones were placed in the

same two locations in the interrupt and the re-orient segments. These tones were located one second after the onset of the segment (+1), and six seconds after the onset of the segment (+6). Therefore the critical tones for measuring attention to the interrupt segment were fired one second after the start of the interrupt segment (measured from the first frame of this segment), and at six seconds after the start of that segment.

Subjects responded to subsequent audio tones placed one second and six seconds after the start of the re-orient segment. Tones were placed five seconds apart so that the primary activity of watching television would not be dominated by the requirements of constantly responding to tones, and so that the reaction time to a particular tone would not be influenced by the responses to the previous tones.

A number of other distractor tones were also located throughout the video sequences. These were used so that subjects would not become accustomed to responding to tones in specific locations, and so the critical tones could not be anticipated. Each sequence contained either six or seven tones in total, four critical tones and either two or three distractor tones. The location of the audio tones relative to each of the four types of sequences is outlined in table 1. For all sequences, a tone was fired six seconds into the start of the initial segment. This was the first distractor tone. For sequences with initial segment durations of 10 seconds, this was the only distractor tone in the initial segment. When the initial segment duration

was 30 seconds, a second distractor tone was included. This tone was randomly located at least five seconds after the first distractor tone, and five seconds before the end of the initial segment. Distractor tones were also located in interrupt segments with durations of 30 seconds, also at least five seconds after the previous tone, and with a minimum of five seconds before the start of the re-orient segment. The final distractor tone was located after the two critical tones in the re-orient segment, if this segment was 30 seconds in length. Again, this tone was located a minimum of five seconds after the last critical tone.

Procedure

Subjects were assigned randomly to one of two conditions reflecting the two presentation orders. The procedure was identical for both groups. Each subject participated in the experiment individually. Subjects were escorted into a viewing room, and seated in a chair located six feet from a television monitor. Subjects were then told by the experimenter that they were participating in a study about how people watch television, and that they would see 24 different sequences of television. While they watched, they were instructed to do two things:
1. First, to pay close attention to the sequences, since they would be asked a number of questions about them later; and
2. While they watched to press a button on a game paddle as quickly as they could whenever they heard an audio tone emitted

from the speaker on the television monitor. After answering any questions, the experimenter stated that the instructions would be repeated in text on the monitor, and that a practice session would be shown prior to the start of the actual experiment. The experimenter then started the videotape and left the room.

The stimulus tape began with 10 seconds of black, followed by a series of instructions displayed in text on the television monitor. There were a total of five different screens of instructions, presented in succession for 10 seconds each. These instructions were followed by 10 seconds of black. A practice session was then presented to allow subjects to acclimate to the tone and to the secondary task. The practice session was a one minute segment from a single program with no interruptions or edits. The program for the practice session was not used in the experiment itself, and the depicted characters were not shown in the subsequent experimental sequences either. The practice program was then followed by another 10 seconds of black, and then by the final text instructions encouraging the subjects to watch carefully and to respond to the tone as quickly as they can. This was followed by another 10 seconds of black, and then the 24 sequences. Each of the sequences was separated by 10 seconds of black as well.

At the completion of the viewing session, the experimenter returned, and debriefed the subjects on the intent and design of the experiment. Subjects were queried to see if they were able to discern and anticipate where the tones were located. No

subjects reported any awareness of a systematic tone location. The experimenter then responded to any questions, and subjects were paid for their participation.

Apparatus

Stimuli were presented in the 1/2" VHS format over a 19" Sony PVM-1910 color monitor. The stimulus sequence was interfaced with an IBM AT computer via a longitudinal time-code output recorded on the second audio channel of the videotape, and read by a digital time-code reader board installed in the computer. Secondary task tones generated by the computer were triggered by a target time code number, routed through a Tascam 106 6X4 mixer, and mixed with the program audio directly into the monitor speaker. The target time code also started the clock in the computer. Responses to the tone (+/- 1 msec.) were made on a CH game paddle, and stored in the computer with the corresponding time code number.

Results

To test attention to television during the orientation to new, interrupt information, a 2 (10 sec, 30 sec initial segment length) by 2 (1 sec after the shift, 6 sec after the shift) repeated measures multivariate analysis of variance was computed. The dependent measure is the latency to response to the audio tone.

No significant differences were found for the between-

subject variable of different message orders. There was a main effect for initial segment length, $F(1,24) = 6.60$, $p<.02$. As predicted in attention hypothesis one, responses were longer when the initial segment was 30 seconds. There was no main effect for the location of the tones relative to the shift between the initial and the interrupt segments, $F(1,24) = .23$, p = n.s. But a significant interaction was found between initial segment length and the location of the tones, $F(1,24) = 15.58$, $p<.001$. Attention increases between one second and six seconds with a 30 sec initial segment, but decreases when there is a 10 second initial segment. No significant differences occurred between 10 second and 30 second initial segments at the one second tone location, $F(1,24) = 2.11$, p = n.s. All of these results are illustrated in figure 1. Hypothesis one was supported; it requires more attention to watch television when the interrupt segment followed a 30 second initial segment, than the initial segment length was 10 seconds.

Integration of New with Previously Presented Information

This section covers the attention required to re-orient to segments that follow an interrupt segment and refer to previously presented information. To test this, a 2 (10 sec, 30 sec initial segment length) by 2 (10 sec, 30 sec interrupt segment length) by 2 (1 sec after the shift, 6 sec after the shift) repeated measures multivariate analysis of variance was computed. Again, reaction time to an audio tone was the dependent measure.

The between-subjects message order factor was not significant. The results did not support attention hypothesis 2; attention was not greater during a re-orient segment when the initial segment was 10 seconds. In fact, the result proved to be opposite to the prediction; subjects were faster and required less attention to re-orient when the initial segment length was 10 seconds, than when it was 30 seconds, $F(1,24) = 4.53$, $p<.05$. These results are illustrated in figure 2.

Attention hypothesis 3 was confirmed; there was a significant main effect for the interrupt segment length, $F(1,24) = 12.43$, $p<.01$. As predicted, reaction times were faster when the interrupt segment was 10 seconds, than when it was 30 seconds (figure 2). There was no main effect for location of the tones. There was a significant interaction, however, between the interrupt segment and the tone location, $F(1,24) = 4.07$, $p<.06$. As illustrated in figure 3, sequences that contained a 30 second initial and a 30 second interrupt segment were especially more difficult to re-orient to at the 6 second tone placement. This trend also produced a significant three-way interaction between initial segment length, interrupt segment length, and tone position, $F(1.24) = 12.07$, $p<.01$. This result is not the product of some outlier within this experimental cell. Of the six sequences that contained 30 second initial and 30 second interrupts segments, five of the six messages demonstrated this trend between the one second and the six second tone placements.

Discussion

The results for attention to an interrupt segment confirmed attention hypothesis 1. More attention was allocated to the interrupt segment when the initial segment was 30 seconds, than when the initial segment was 10 seconds. This difference was dependent upon the juncture where attention was measured, as indicated by the interaction of tone location and segment length. One second after the start of the interrupt segment, there was no difference in attention as a function of the length of the initial segments. It appears, therefore, that structure dominates within one second after the onset of a cut that ties together disparate segments. This result supports previous findings that have attributed an automatic attention response to cuts that occur between segments (Geiger & Reeves, 1989). When the shift between the initial and the interrupt segments takes place, viewers automatically allocate attention in order to make sense of the shift and orient to the new information. When this new information is unrelated to the information from the previous segment, the greatest demands on attention relative to the shift is located one second after the shift. Hence, the one second time point after the shift to the interrupt segment is measuring the response to the shift itself, which is unaffected by the length of the initial segment.

There was a significant difference between attention to 10 and 30 second interrupt segments when measured six seconds after the start of the interrupt segment. When the initial segment was

30 seconds in length, attention to the interrupt segments increased between the one second and the six second tone location. This contrasts with the case of the 10 second initial segment, which demonstrated reduced attention over time. This interaction may be attributable to the way in which subjects regarded the information presented in the interrupt segment. When an interrupt followed a long initial segment, it may have been relatively difficult to dismiss the prior information and focus on the current segment. Because of the greater investment applied to the longer initial segments, viewers may have attempted to make sense of the two segments as one unit, therefore expending effort in trying to integrate the two segments. In the case of the 10 second initial segment, subjects quickly shifted from the initial segment to the interrupt segment, with little or no effort exerted to make sense of the two segments together. Less effort was expended over time when an interrupt followed a 10 second initial segment. Therefore, the longer the investment in a developing sequence, the more difficult it was to switch to a new sequence.

Attention hypothesis 2 predicted that sequences that contained 10 second initial segments would require more attention during the re-orient segments than 30 second initial segments would. The results proved the opposite. Overall, subjects responded more quickly, and required less attention when the length of the initial segment in the sequence was 10 seconds, than when the initial segment length was 30 seconds. It appears

then that the critical factor in attention and re-orienting is not the amount of previously presented information. In fact, when longer initial sequences are presented, more attention is required.

Two explanations for this result will be considered. The first is simply that the more information a viewer has to refer back to, the more time and attention is required to activate it. Therefore, when the initial segment is 30 seconds, the greater number of thoughts generated during this longer period of viewing will require more time and mental effort. This explanation is supported by research in cognitive psychology that has found that the recognition time for sentences is longer when it contains a subject that has a greater number of facts associated with it (J. R. Anderson, 1974). The second explanation focuses on the expectations that viewers have while they watch television, expectations that may be determined in part by a gestalt-like notion of closure and completeness (Garner, 1974). When a short segment is presented, viewers may perceive this as an incomplete presentation. At the conclusion of the 10 second initial segment, viewers may have a greater expectation that more information will be presented that will complete the earlier aborted presentation. As a result some of the nodes that represent the initial segment are kept active in working memory. On the other hand, when longer segments are presented, they would be perceived as more complete messages. Therefore, when an interrupt segment follows a 30 second initial segment, viewers

are more likely to shift their activation away from the nodes that represent this segment. In the case of a 10 second initial segment (A1), the expectation that this message will be continued is reflected by continued activation for information from the initial segment. Then, in the case of the sequences with 10 second initial segments, when the re-orient segment is presented, some of the relevant nodes are already activated, and so less attention is required.

The results confirmed attention hypothesis 3; less attention was required during the re-orient segment when the interrupt segment length was 10 seconds, than when the interrupt segment length was 30 seconds. This result provides strong support for the distinction between integration and reinstatement. When a 10-second interrupt intervenes between the initial and the re-orient segments, certain nodes activated during the initial segment remain active in working memory. The more attention-demanding reinstatement is required when a 30-second segment interrupts the initial and the re-orient segments, since the nodes activated during viewing of the initial segment must be completely re-activated. This effect is especially pronounced six seconds into the re-orient segment, when both the initial and the interrupt segments are 30 seconds in length. It appears then that the complete activation of previously presented information not only requires more attention, but takes longer to reach an asymptote in activation.

This study contributes to an increasing body of work on how

attention to television varies over time in response to message attributes. What makes this study unique and, what in part defines its contribution, are the message factors that are manipulated: the duration of a segment, and the relationship between segments within a sequence. The manipulation of segment duration provided an opportunity to look at how the time spent viewing one thing influences the processing of something else. Different segment lengths were found to influence attention to other segments in a sequence.

These results clearly illustrate the interdependence of message units within a sequence. When the message unit is defined as a segment, then the attention results can be understood in terms of a context effect. Context effects in television processing have focused on how what preceded and/or followed a message have affected processing of that message, such as the influence of mood congruency upon attention and memory (Reeves et al., 1989), the effect of a sub-threshold semantic prime on affective judgements, (Reeves et al., 1988), and the release from pro-active interference in memory for news broadcasts (Gunter et al., 1980; 1981). The fact that order effects exist, i.e. that one segment influences another, is now considered a given in message processing research. Framing these results exclusively in terms of a context effect however, dismisses the importance of how viewers might treat message units. The design of this study also allows for the message unit to be defined as the sequence. Television viewing is based on

the comprehension of sequences; sequences that are composed of segments within a program, as well as sequences that include shifts between programs. By looking at sequences of television, it is possible to describe more natural television viewing behavior. Future research should focus on integrating natural aspects of the television stimulus, with an experimental agenda that treats television viewing as a cognitive process.

FIG. 1. Attention to interrupt segments 'Reaction time to an audio tone by tone location and initial segment length'

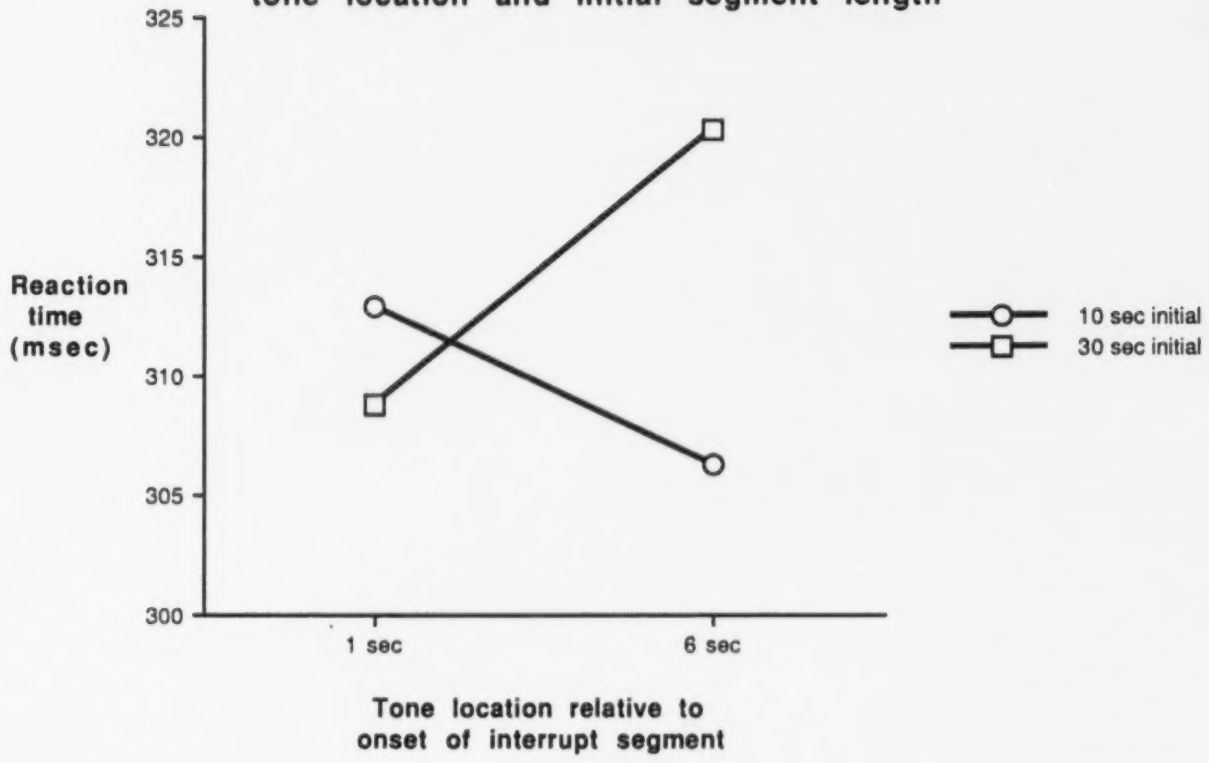


FIG. 2. Attention to re-orient segments
'Reaction time to an audio tone
by initial segment length'
and interrupt segment length"

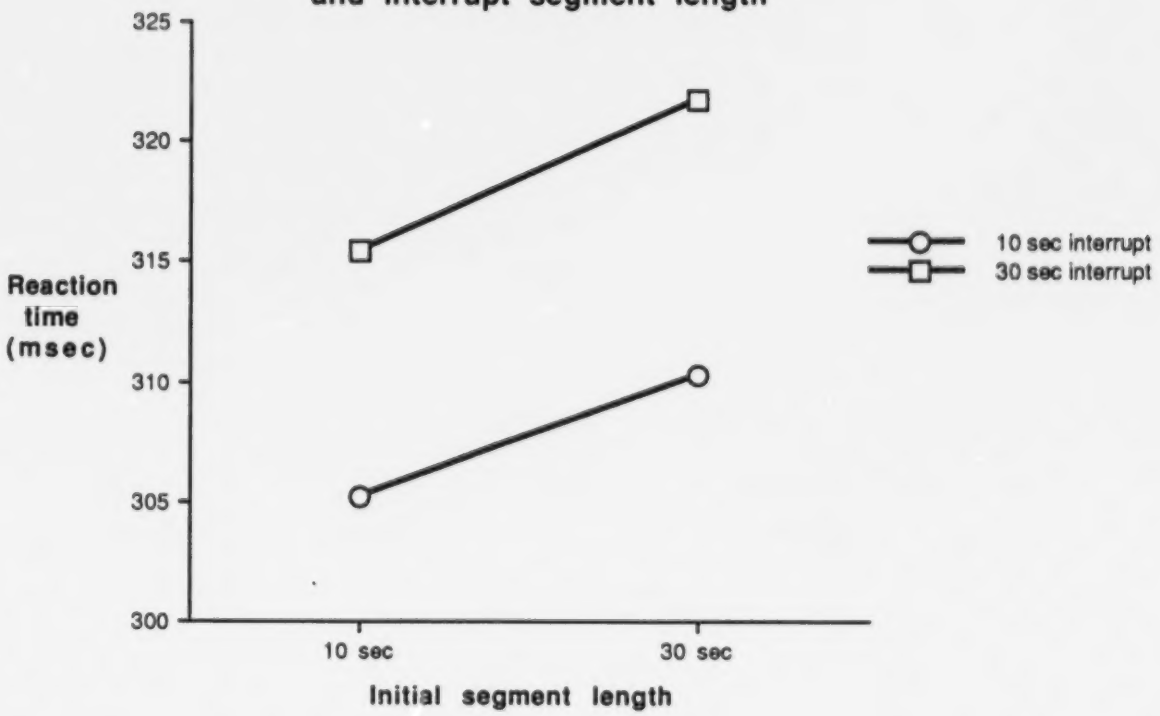
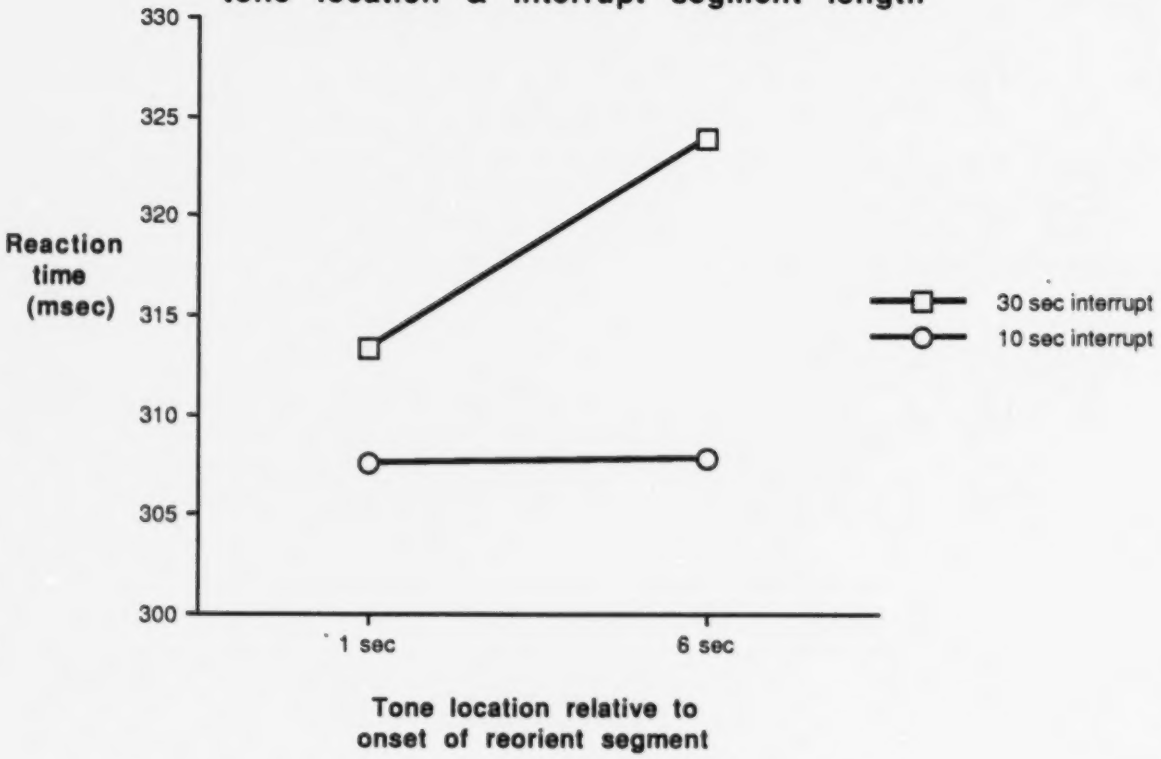


FIG. 3. Attention to re-orient segments
'Reaction time to an audio tone by
tone location & interrupt segment length'



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